# Weekly Updates (5/10/2023) – Krishna Tarun Saikonda

**Flow Attribute:**

I've made significant modifications to vehicle insertion and positioning within the simulation. By utilizing specific flow attributes, I've gained greater control over how vehicles are introduced and positioned, as well as the speeds at which they enter the simulation. These adjustments have proven invaluable in conducting controlled experiments and have significantly enriched our research efforts.

| Attribute | Value | Explanation |
|---|---|---|
| id | f_0 | Identifier for the flow. |
| begin | 0.00 | Start time for the flow in simulation (seconds). |
| from | E0 | Starting edge or location for the flow. |
| to | E2 | Destination edge or location for the flow. |
| end | 600.00 | End time for the flow in simulation (seconds). |
| number | 500 | Number of vehicles to be generated in this flow. |
| departPos | random | Departure position type, set to random. |
| departLane | free | Departure lane type, set to free. |
| departPosLat | random_free | Lateral (sideways) departure position type, set to random_free. |
| arrivalPos | random | Arrival position type, set to random. |
| arrivalLane | random | Arrival lane type, set to random. |

## Scenario 1:
## Studying different type of Collisions with EIDM Car Following Model in Highway Simulation with specifying one parameter at a time.

In this scenario, we aim to study rear-end collisions in a highway simulation while isolating specific parameters one at a time in the EIDM car-following model. The objective is to understand how individual parameter variations affect rear-end collisions.

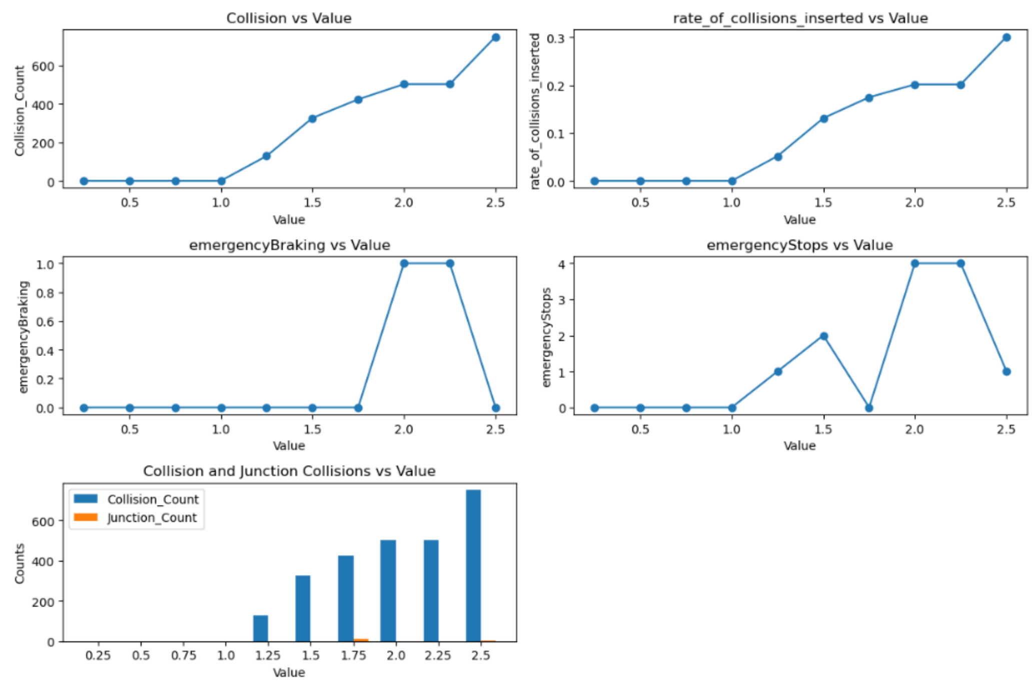
In a thorough investigation of collision scenarios within a highway simulation, a range of parameters were scrutinized to assess their impact on multiple collision types, including rear-end, junction, and lane change collisions. Among these parameters, 'tau,' 'collisionMinGapFactor,' and 'sigmaerror' stood out as significant factors that influenced the frequency and characteristics of these collisions. These parameters, operating in the context of the EIDM car-following model, played a pivotal role in shaping collision outcomes across various scenarios. This highlights the importance of carefully tuning and optimizing these specific parameters to enhance overall traffic safety and mitigate collisions of diverse natures within the simulation environment.

**Results:**

**CollisionMinGapFactor:**

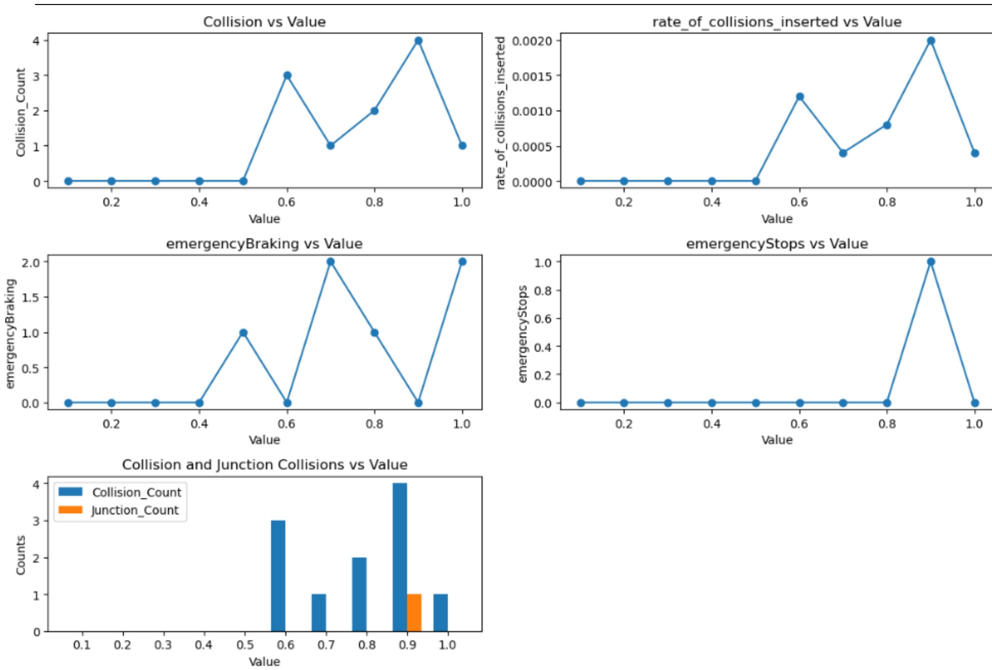
Parameter: Minimum gap between vehicles.
Key Observations:

- Collision rate remains at 0% until the minimum gap (Value) reaches 1.25, indicating that a minimum gap of 1.25 is necessary to avoid collisions.
- Smaller minimum gaps lead to more aggressive braking and stopping behavior, as seen in the increase in emergency braking and stops as the minimum gap decreases.
- "Collision_Count" aligns with the collision rate, showing the total number of collisions for each minimum gap.
- No data is available for junction-related incidents ("Junction_Count" has "NaN" values)



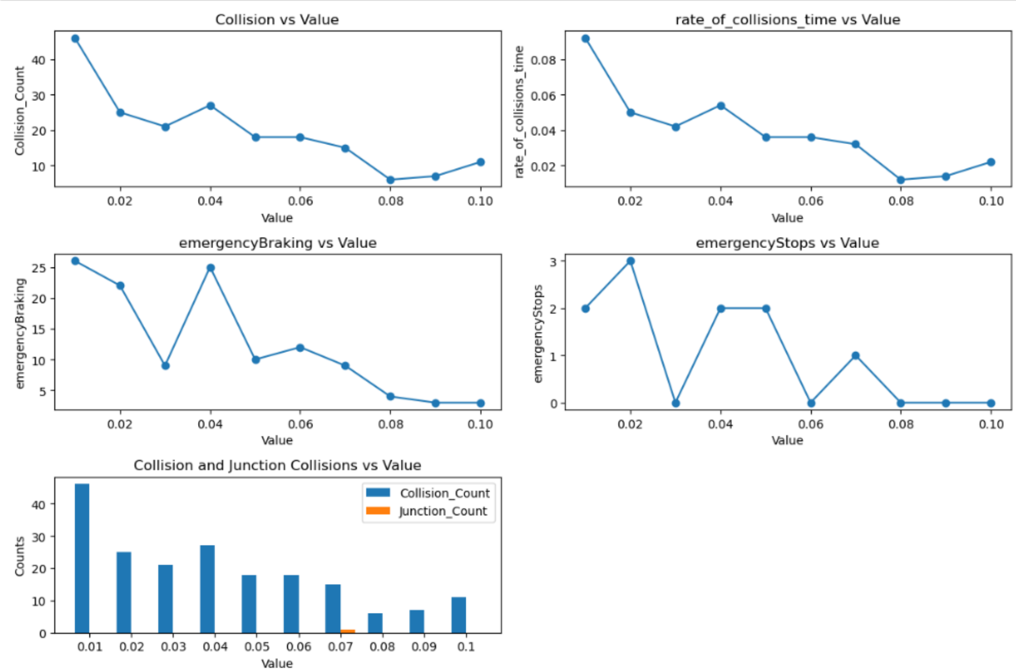

**SigmaError:**

- Parameter: Sigma error, likely related to driver behavior or error modeling.
- Key Observations:
- Higher values of sigma error (Value) are associated with increased collision rates, emergency braking, and emergency stops, suggesting more collisions and aggressive driving with higher error rates.
- "Collision_Count" corresponds with the collision rate, reflecting the total number of collisions for each sigma error value.
- "Junction_Count" is mostly not available (contains "NaN" values), indicating a lack of data regarding junction-related incidents.



**Tau:**

- Parameter: Tau, representing driver reaction time.
- Key Observations:
- Larger values of tau (Value) result in decreased collision rates, emergency braking, and emergency stops, implying that slower driver reaction times lead to safer driving.
- "Collision_Count" matches the collision rate, providing the total number of collisions for each tau value.
- "Junction_Count" is mostly not available (contains "NaN" values), indicating a lack of data regarding junction-related incidents.




**Comparative Analysis:**

- The variation in parameters (minimum gap, sigma error, and tau) influences driving behavior and collision rates.
- A smaller minimum gap and higher sigma error lead to increased collisions and more aggressive driving behavior.
- Conversely, a larger tau value, indicating a slower driver reaction time, results in fewer collisions and less aggressive driving behavior.
- Further analysis with complete data, including junction-related incidents, could provide a more comprehensive understanding of how these parameters impact overall traffic safety in simulations.
- Understanding the effects of these parameters is crucial for traffic modeling and simulation to enhance safety measures and optimize traffic flow in real-world scenarios.

## Scenario 2:
## Studying different type of Collisions with EIDM Car Following Model in Highway Simulation by keeping tau as 0.01 and changing the parameters one at a time.

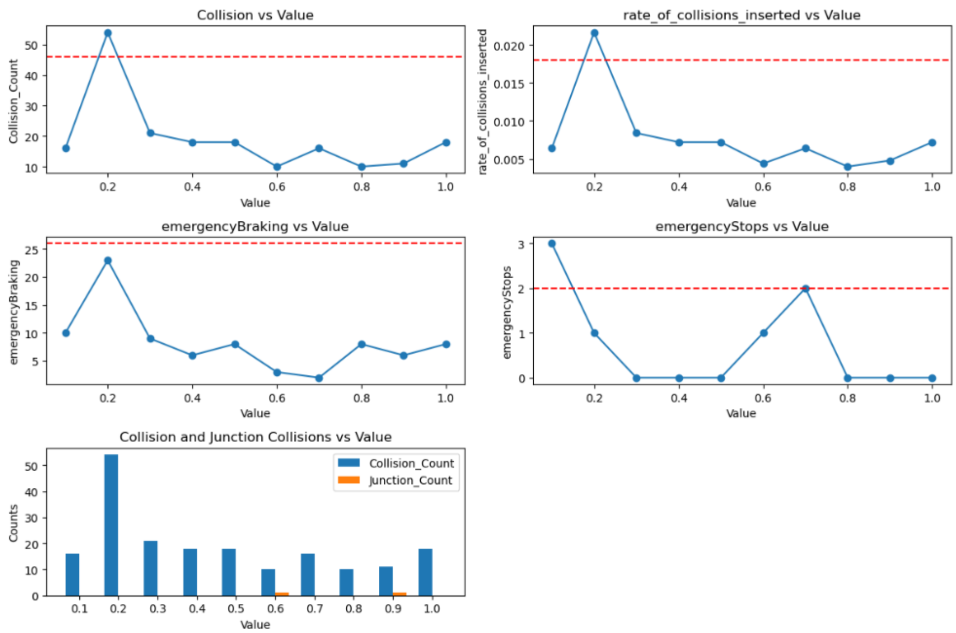
In this scenario, I am conducting a comprehensive exploration to understand how various parameters impact the occurrence of different types of collisions within a highway simulation. To maintain a controlled environment, I am keeping the parameter "tau" constant at a value of 0.01 throughout the experiments.

I am systematically investigating whether the frequency of collisions increases or decreases when compared to the standard "tau" value of 0.01. This evaluation involves varying one parameter at a time while keeping "tau" constant to determine the impact of each parameter change on collision occurrences. By comparing these outcomes to the baseline scenario with the standard "tau" setting, I can discern whether specific parameter adjustments lead to an increase or decrease in collision events within the highway simulation.

**1.Car-Following Model Parameters:**

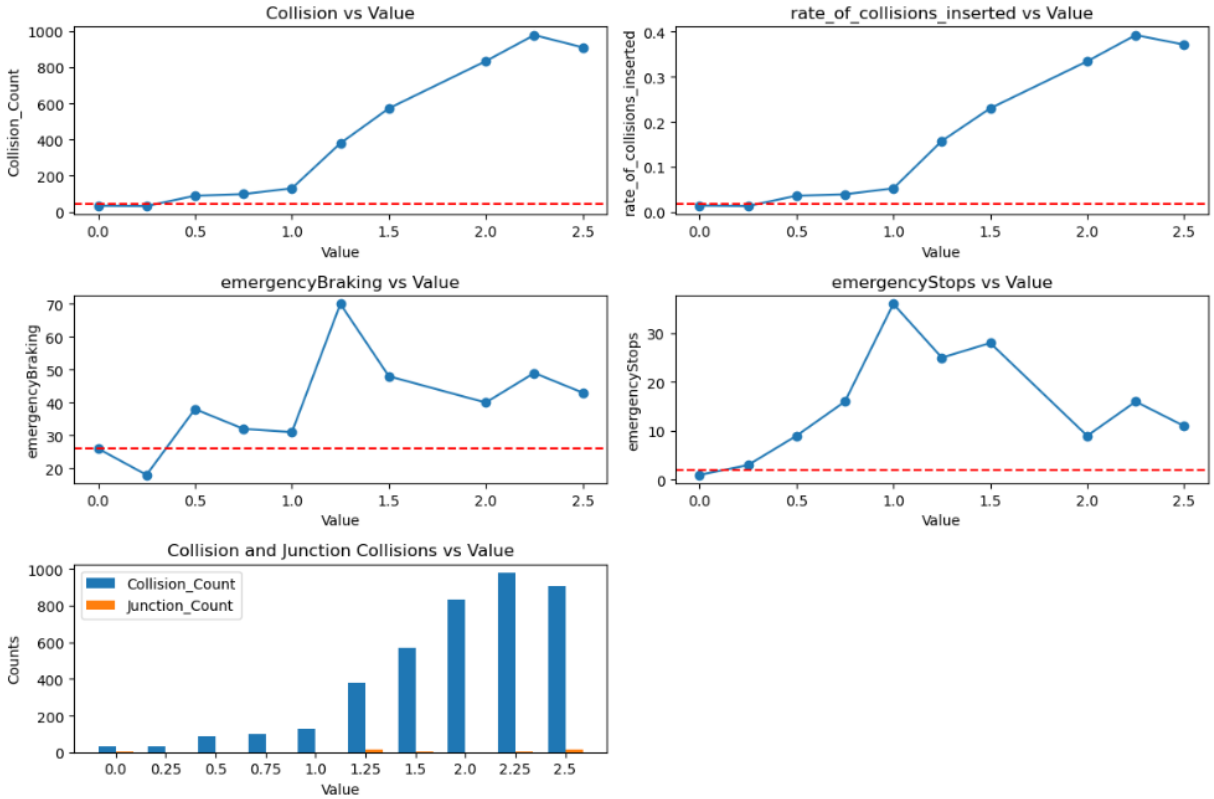
**1.1. Sigma Error:**

- rate_of_collisions_inserted:
  - Increases as the parameter value (sigma) increases.
  - Indicates a higher rate of collisions with higher sigma values.
- Collisions:
  - Increases with higher sigma values.
  - Significantly higher collision rates with sigma values of 1.25 and 2.5.
- Emergency Braking:
  - Correspondingly increases with sigma.
  - Higher sigma values result in more frequent emergency braking.
- Emergency Stops:
  - Increases with sigma, especially at sigma values of 1.25 and 2.5.
  - Signifies a higher number of emergencies stops in these scenarios.
- Junction Count:
  - Junction-related incidents are recorded in some cases, particularly with sigma values of 1.25 and 2.5.



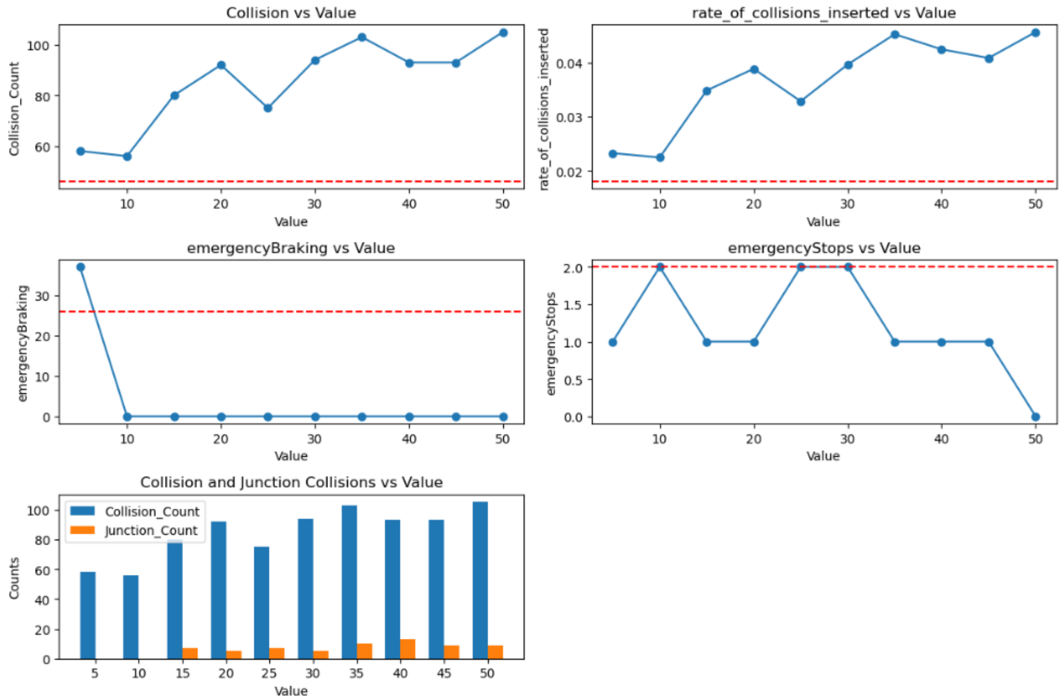

**1.2. CollisionMinGapFactor:**

- Rate_of_collisions_inserted:
  - Varies with collision min gap factor values.
  - Indicates that different factors can affect collision rates.
- Collisions:
  - Increases with collision min gap factor, suggesting more collisions as the factor increases.
- Emergency Braking and Stops:
  - Noteworthy increase with collision min gap factor.
  - Suggests that higher collision min gap factors lead to more emergency braking and stops.
- Junction Count:
  - Junction-related incidents are recorded in these scenarios.



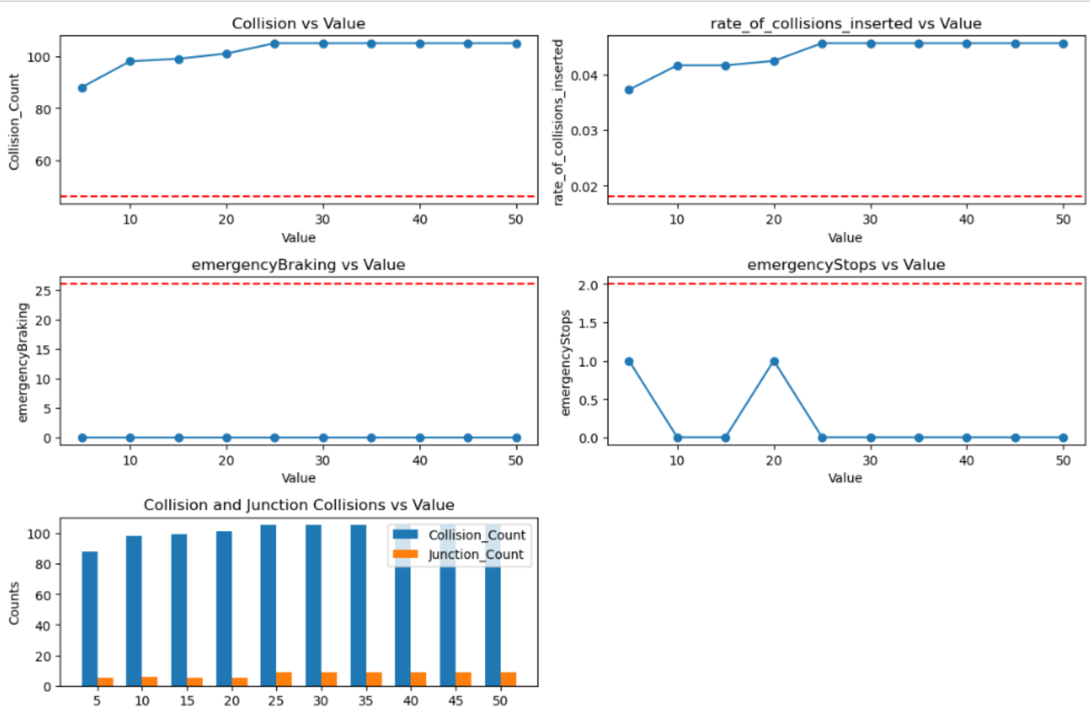

**1.3. Decel:**

- rate_of_collisions_inserted:
  - Increases with higher deceleration values.
  - Signifies a higher collision rate when deceleration is more aggressive.
- Collisions:
  - Correspondingly increases, indicating more collisions with aggressive deceleration.
- Emergency Braking and Stops:
  - Increase with higher deceleration values, suggesting more intense braking and stopping.
- Junction Count:
  - Junction-related incidents are reported in some scenarios.



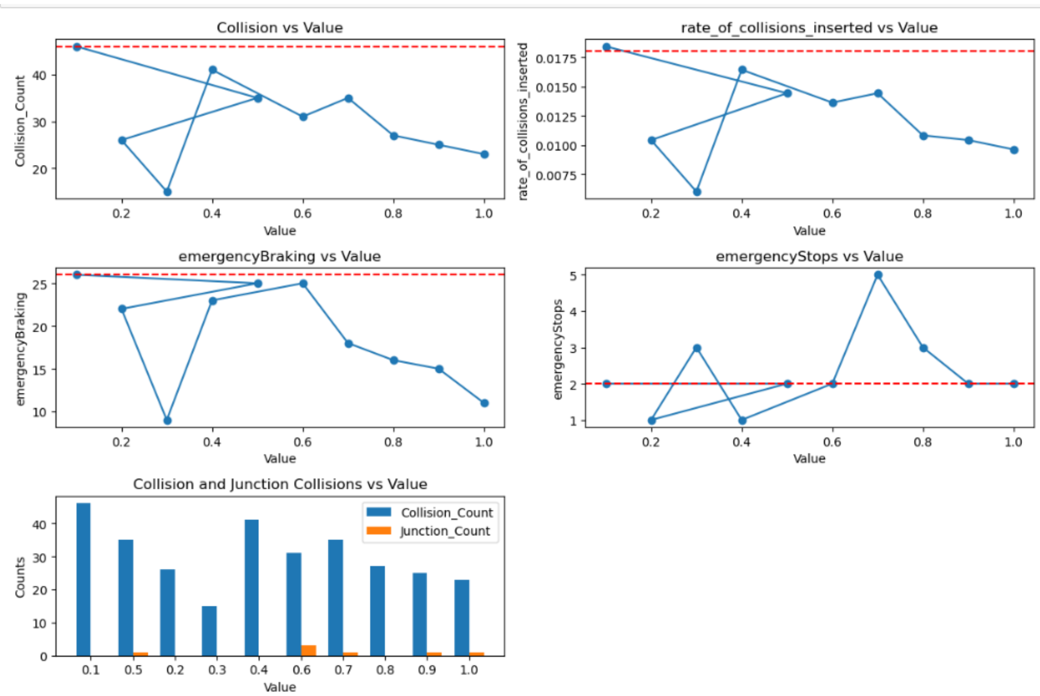

**1.4. Emergency Decel:**

- rate_of_collisions_inserted:
  - Varies with different emergency deceleration settings.
  - Suggests that this parameter affects collision rates.
- Collisions:
  - Increases with higher emergency deceleration settings.
  - Signifies more collisions with aggressive emergency deceleration.
- Emergency Braking and Stops:
  - Both metrics increase, indicating higher braking and stopping incidents in scenarios with aggressive emergency deceleration.
- Junction Count:
  - Junction-related incidents are recorded in some cases.



**1.5. Sigma gap:**

- rate_of_collisions_inserted:
  - Increases as sigma gap values increase.
  - Suggests that higher sigma gap settings result in higher collision rates.
- Collisions:
  - Correspondingly increases, indicating more collisions with higher sigma gap settings.
- Emergency Braking:
  - Increases with higher sigma gap values, suggesting more frequent emergency braking.
- Emergency Stops:
  - Also increases, signifying more intense stopping in scenarios with higher sigma gap values.
- Junction Count:
  - Junction-related incidents are documented in some scenarios.




## Comparative Analysis:

**For the reference scenario with tau = 0.01:**

- `rate_of_collisions_inserted`: 0.092
- `rate_of_collisions_inserted`: 0.0184
- `Collisions`: 46
- `emergencyBraking`: 26
- `emergencyStops`: 2
- `loaded`: 2496
- `inserted`: 677
- `running`: 40
- `Collision_Count`: 46

**Sigma Error Collisions:**

The scenario with `sigma` set to 1.25 reports 393 collisions, which is significantly higher than the reference scenario. However, it also has the highest `emergency Braking` and `emergency Stops`, indicating that safety measures are being actively used.

**Collision Min Gap Factor Collisions:**

In the scenario with `collision min gap factor` set to 10, it reports 56 collisions, which is higher than the reference but lower than the high sigma scenario. However, it has zero `emergency Braking` and only 2 `emergency Stops`.

**Deceleration Collisions:**

The scenario with `decel` set to 5 has 93 collisions, which is higher than the reference. It doesn't report `emergencyBraking` or `emergencyStops`, suggesting collisions are caused by the aggressive deceleration itself.

**Emergency Deceleration Collisions:**

In the scenario with `emergencyDecel` set to 0.5, it reports 36 collisions, which is comparable to the reference scenario. It has 25 `emergencyBraking` events, which is higher than the reference.

**Sigma Gap Collisions:**

The scenario with `sigmaGap` set to 15 reports 87 collisions, which is higher than the reference but lower than the high sigma scenario. It doesn't report `emergencyBraking` or `emergencyStops`.

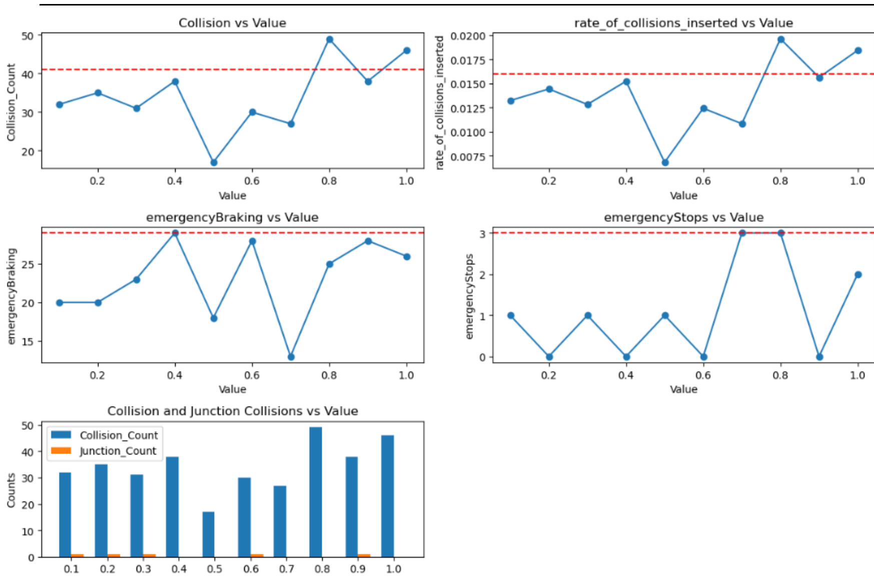
**Summary:**

- The sigma error scenario with sigma = 1.25 has the highest collision count but also the highest usage of safety measures.
- The collision min gap factor of 10 results in collisions without emergency safety measures.
- The deceleration setting of 5 leads to collisions without emergency measures as well.
- The emergency deceleration setting of 0.5 has a collision count similar to the reference but more emergency braking events.
- The sigma gap setting of 15 results in collisions without emergency measures.

## 2.Lane-change Model Parameters:

### 2.1. lcAssertive_Metrics:

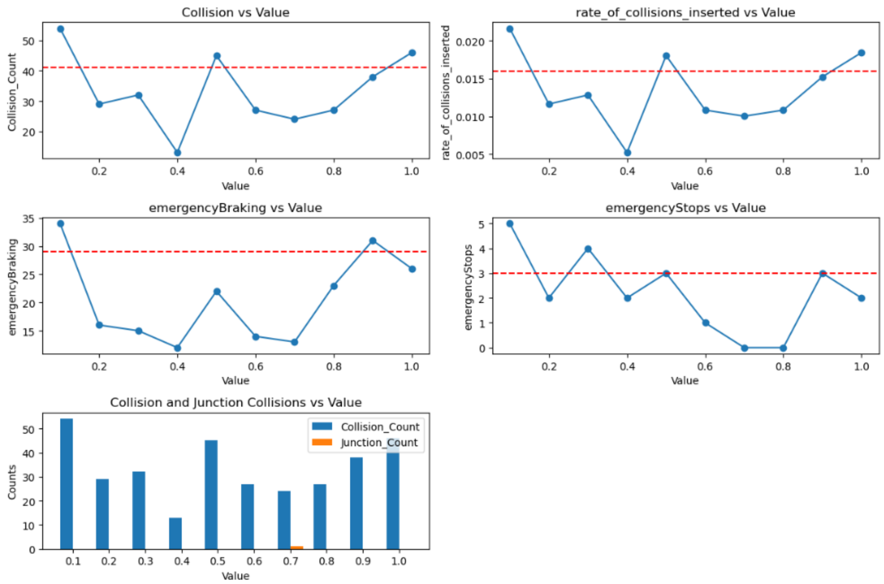
- rate_of_collisions_inserted varies from 0.066 to 0.110, indicating that assertive behavior tends to increase the rate of collisions compared to the baseline.
- The baseline had 41 collisions, and the assertive behavior led to collision rates ranging from 23 to 55.
- Emergency braking and stops are higher in most assertive scenarios, suggesting a more aggressive driving style.
- Junction-related incidents are documented.




### 2.1. lcCooperative:

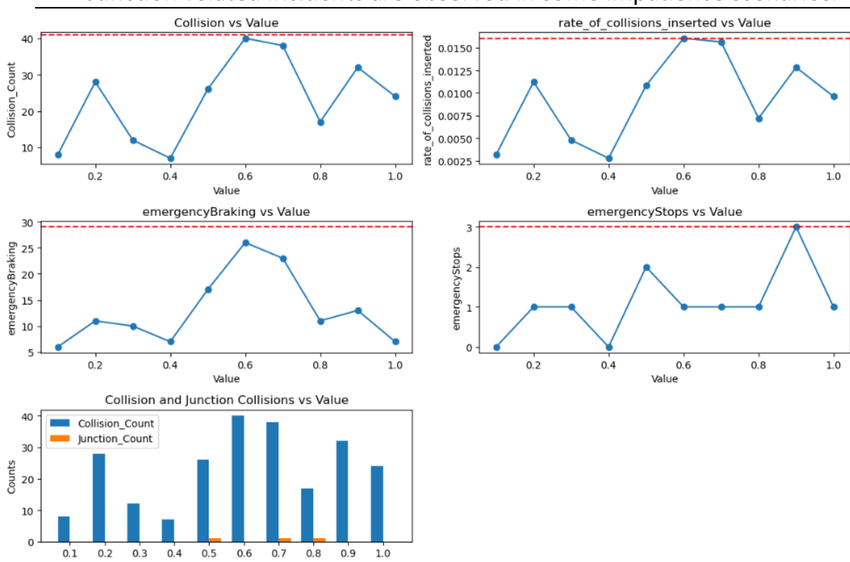
- rate_of_collisions_inserted is relatively stable, indicating that cooperative behavior doesn't significantly impact collision rates compared to the baseline.

- The baseline had 41 collisions, and cooperative behavior leads to collision rates ranging from 23 to 45.
- Emergency braking and stops remain consistent.
- No junction-related incidents are reported.



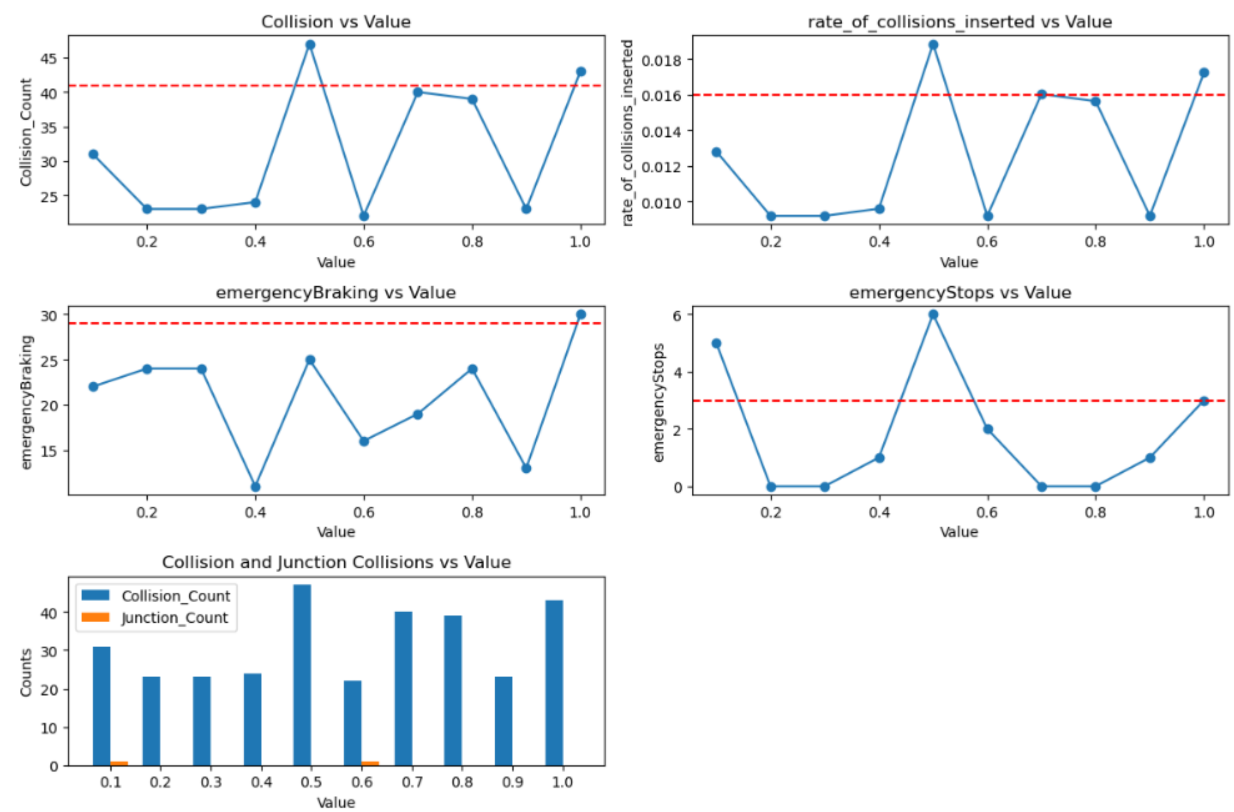

**2.3. lcImpatience_metrics:**

- rate_of_collisions_inserted varies from 0.046 to 0.094, indicating that impatience can either decrease or increase the rate of collisions compared to the baseline.
- The baseline had 41 collisions, and impatience led to collision rates ranging from 23 to 47.
- Emergency braking and stops show variations.
- Junction-related incidents are observed in some impatience scenarios.



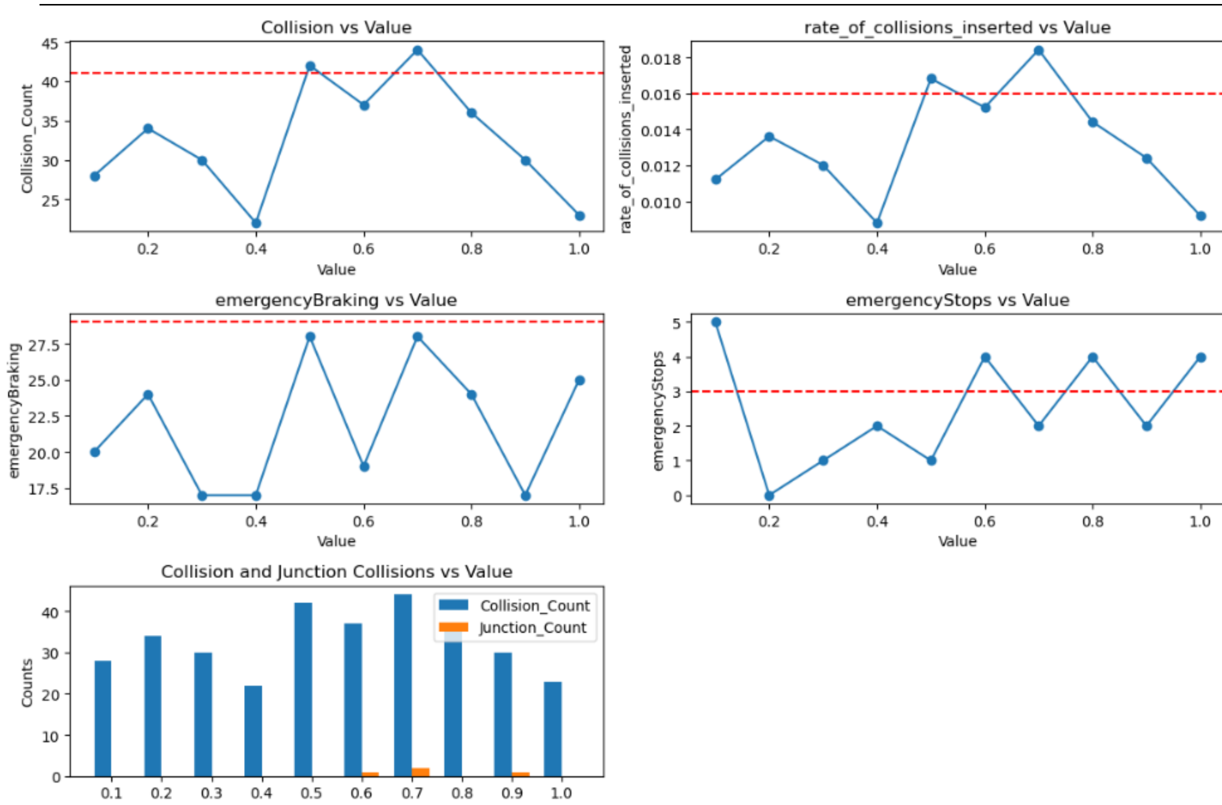

**2.4. lcPushy:**

- rate_of_collisions_inserted varies from 0.046 to 0.092, indicating that pushy behavior can increase the rate of collisions compared to the baseline.
- The baseline had 41 collisions, and pushy behavior led to collision rates ranging from 23 to 46.
- Emergency braking and stops are higher in pushy scenarios.
- Junction-related incidents are reported in some pushy scenarios.



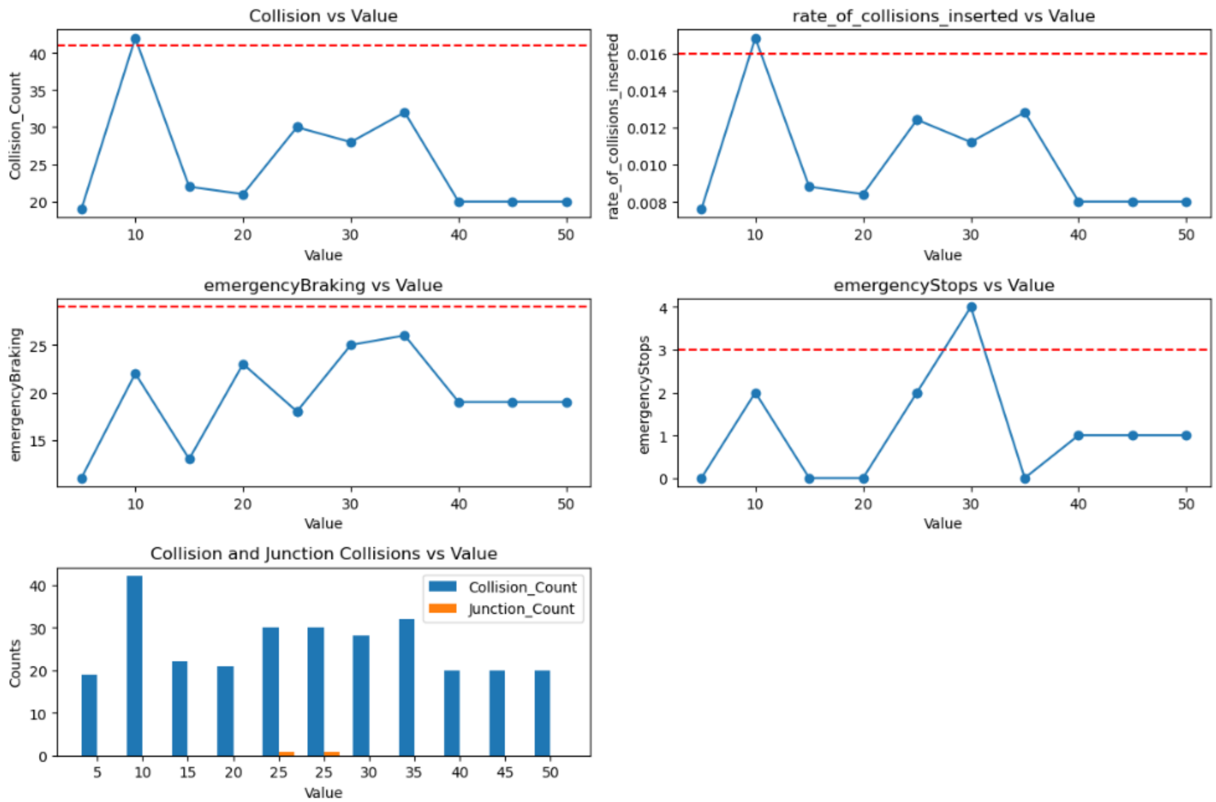

**2.5. lcSigma:**

- rate_of_collisions_inserted varies with sigma values, but the relationship is not always straightforward, suggesting mixed impacts on collision rates compared to the baseline.
- The baseline had 41 collisions, and sigma values led to varying collision rates.
- Emergency braking and stops also fluctuate with sigma values.
- Junction-related incidents are not documented.

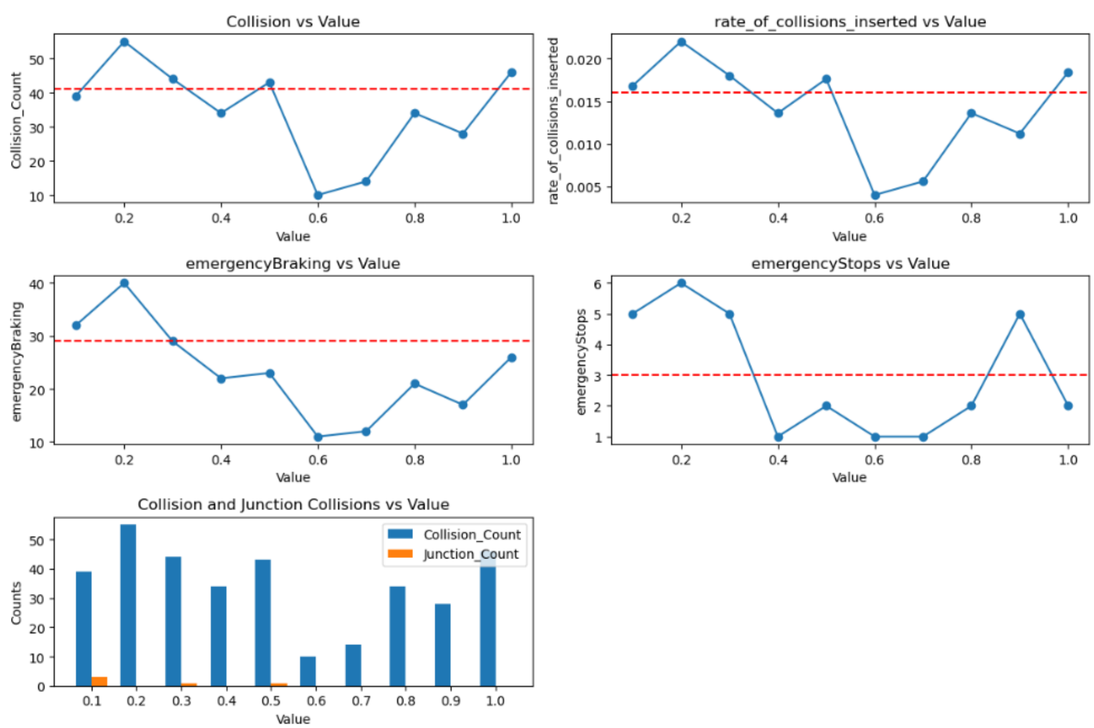


## 2.6. lcSpeedGain:

- rate_of_collisions_inserted varies from 0.020 to 0.092, indicating that higher speed gain can increase the rate of collisions compared to the baseline.
- The baseline had 41 collisions, and speed gain led to collision rates ranging from 10 to 46.
- Emergency braking and stops are higher with higher speed gain.
- Junction-related incidents are observed in some speed gain scenarios.




## 2.7. lcStrategic:

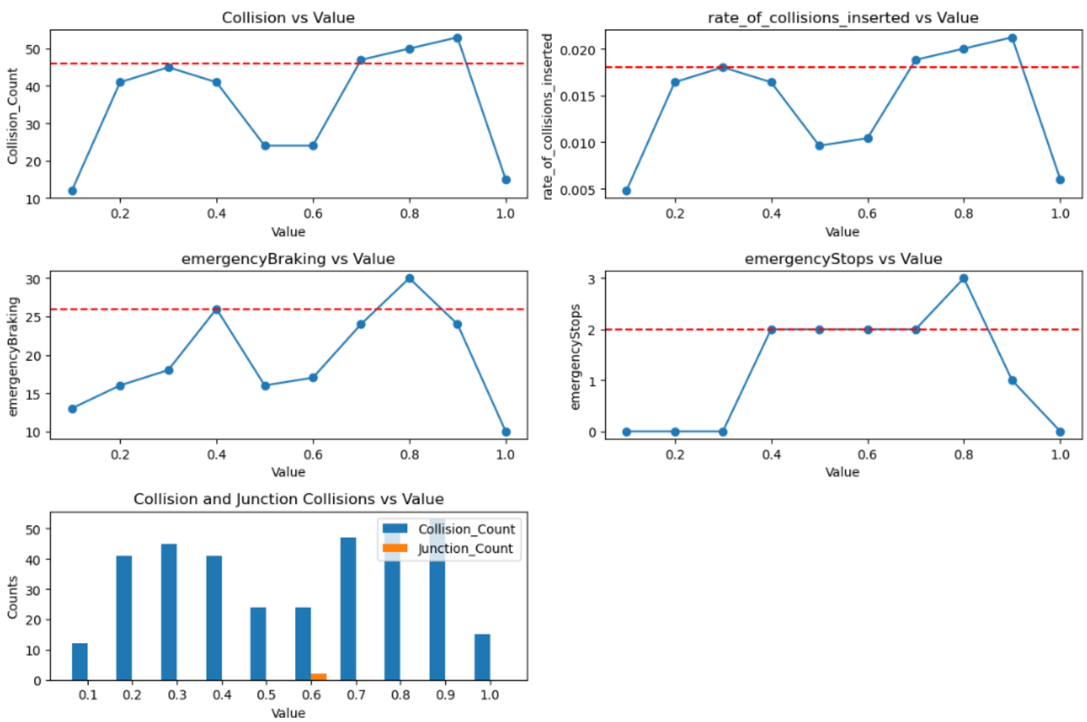


**Comparative Analysis:**

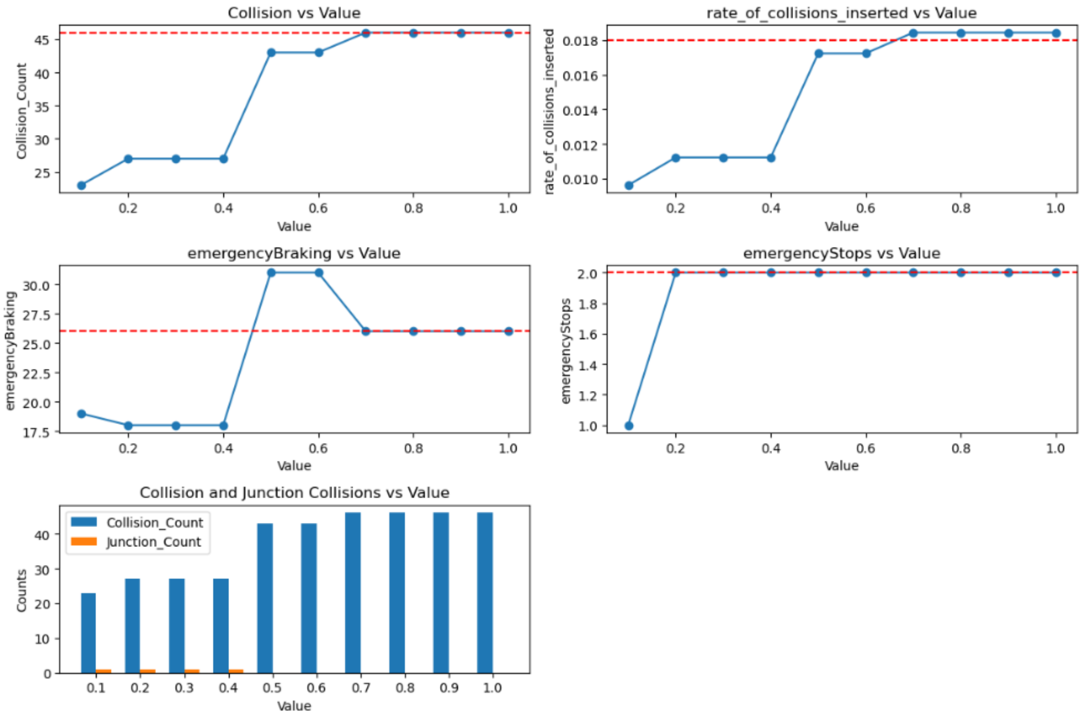
1. Among the parameters studied, assertive, pushy, and speed gain behaviors tend to result in higher collision rates compared to the baseline scenario.
2. Impatience can either increase or decrease collision rates, showing a mixed impact.
3. Cooperative behavior and sigma show more moderate effects on collision rates, with fewer clear trends.
4. The presence of junction-related incidents varies across scenarios but is not well-documented in most datasets.
5. In summary, these parameter-specific analyses show how each parameter can affect collision rates and driver behavior compared to the baseline scenario with tau at 0.01. Researchers can use this information to fine-tune parameters and optimize traffic safety in simulations.

## 3.Junction Model:

### 3.1. jmIgnoreJunctionFoeProb:




### 3.2. jmTimegapMinor:




**Comparative Analysis with jm Parameters:**

**jmIgnoreJunctionFoeProb:**
- `jmIgnoreJunctionFoeProb` at 0.1: Resulted in 24 collisions with 19 emergency braking events and 1 emergency stop. This scenario had fewer collisions and more emergency actions compared to the standard scenario.

**jmTimegapMinor:**
- `jmTimegapMinor` at 0.1 and 0.2: Resulted in 41 collisions in both cases, similar to the standard scenario. Emergency braking events were relatively low, suggesting that these collisions might not have required emergency measures.

**Analysis:**
- The "jmIgnoreJunctionFoeProb" scenario with `jmIgnoreJunctionFoeProb` at 0.1 had fewer collisions than the standard scenario but more emergency actions.
- The "jmTimegapMinor" scenarios at 0.1 and 0.2 had similar collision rates to the standard scenario but with lower emergency measures.

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## Scenario 3:

## Comparative Analysis of Collision Incidents Between Default and Krauss Vehicle Types by Keeping One Vehicle Type Constant at a Time.

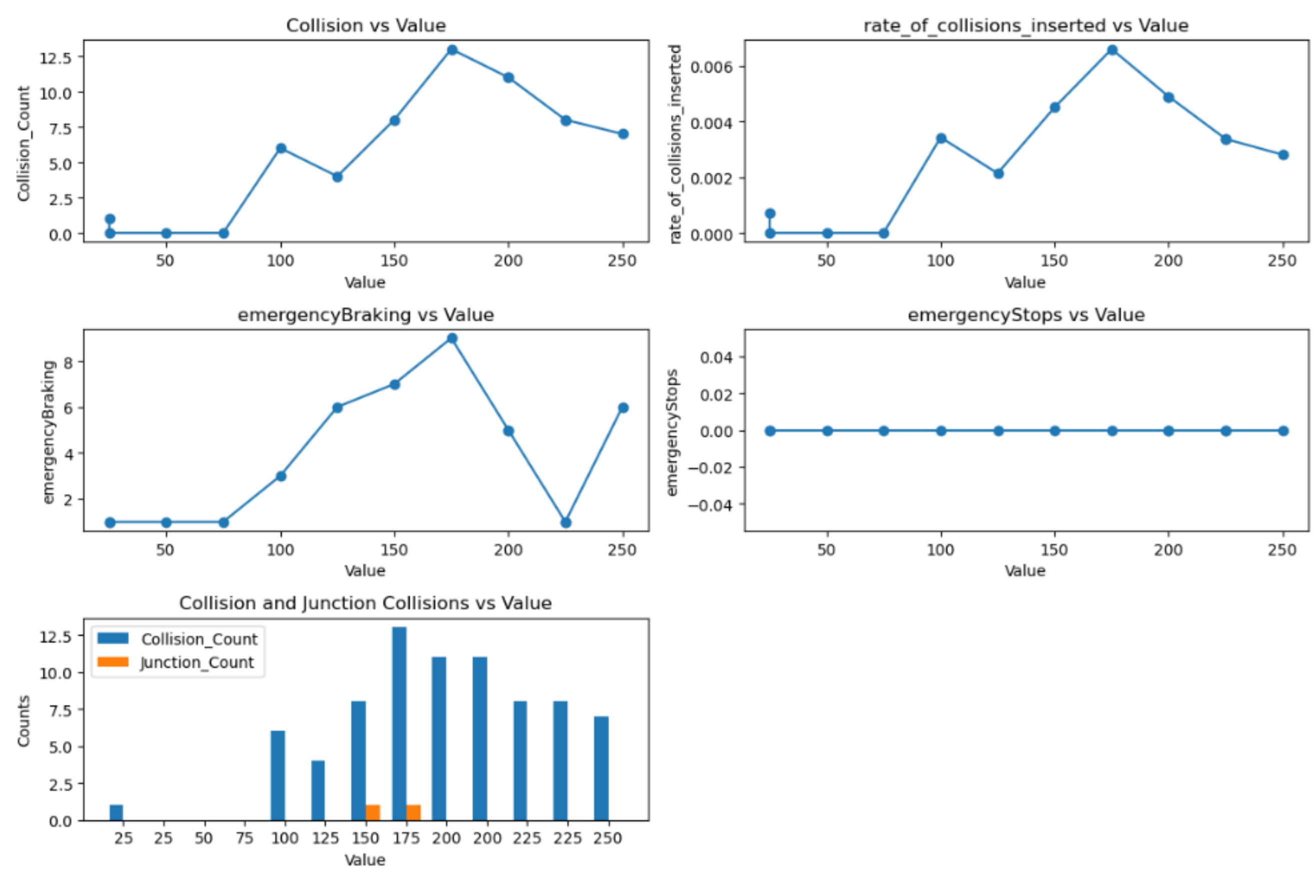
In the provided data, I've conducted two experiments involving different types of vehicles, Default and Krauss, to understand the impact of their characteristics on collisions. In one experiment, you kept the Default type constant and varied the Krauss type, while in the other experiment, you kept the Krauss type constant and varied the Default type.

**3.1. Krauss as Constant, Default Type Changed:**

- In this experiment, I kept the Krauss type constant while varying the Default type.

- The key metrics include `rate_of_collisions_inserted`, `rate_of_collisions_inserted`, `Collisions`, `emergencyBraking`, `emergencyStops`, `loaded`, `inserted`, `running`, `Collision_Count`, `Junction_Count`.

**3.1.1Analysis of First Experiment:**




- As I increase the Default type, you observed an increase in the `rate_of_collisions_inserted`. This indicates that higher Default types are associated with more collisions per unit of time.

- `rate_of_collisions_inserted` also increased as Default type increased, suggesting that more collisions occurred with higher Default types per inserted vehicle.

- The number of `emergencyBraking` and `emergencyStops` also increases with higher Default types.

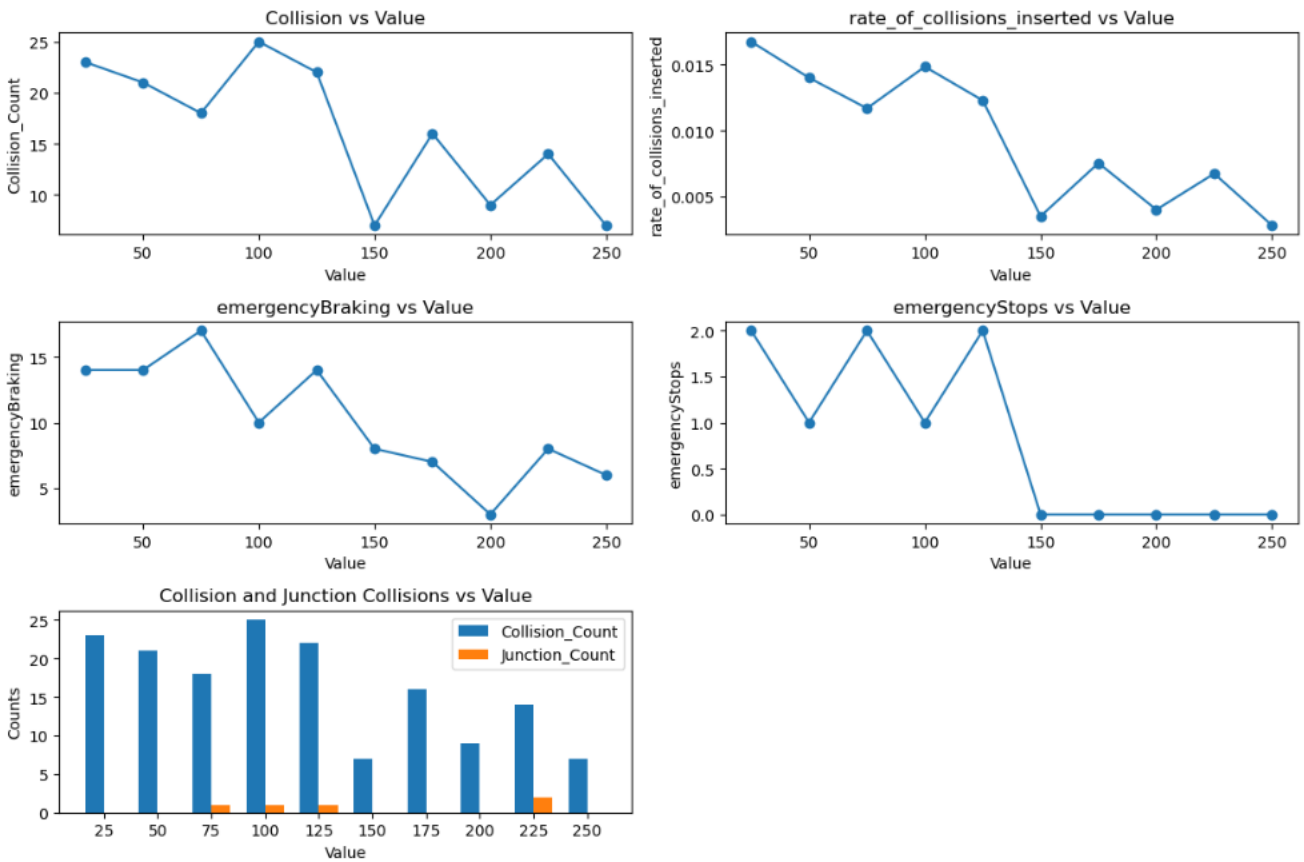
- The total number of `Collision_Count` is significantly higher when Default type is increased.

### 3.2. Default as Constant, Krauss Type Changed:

- In this experiment, I kept the Default type constant and varied the Krauss type.

- Similar key metrics include `rate_of_collisions_inserted`, `rate_of_collisions_inserted`, `Collisions`, `emergencyBraking`, `emergencyStops`, `loaded`, `inserted`, `running`, `Collision_Count`, `Junction_Count`.

### 3.2.1Analysis of Second Experiment:




- Unlike the first experiment, in this scenario, varying the Krauss type didn't result in significant changes in the `rate_of_collisions_inserted` and `rate_of_collisions_inserted`.

- `emergencyBraking` and `emergencyStops` show some fluctuations but are not significantly impacted.

- The total `Collision_Count` varies moderately, but it's less pronounced compared to the first experiment.

### 3.3. Overall Analysis:

- In the first experiment, it's evident that increasing the Default type results in significantly more collisions, including a higher rate of collisions and emergency braking/stopping.

- In the second experiment, varying the Krauss type has a less dramatic impact on collisions.